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and, consequently, the  $\triangle MNO = \frac{1}{8}(\mathbf{N})^2 / \sin A \sin B \sin C \dots (5)$ . The expression for the average area of the  $\triangle MNO$ , therefore, becomes

$$\mathbf{A} = \frac{1}{8abc \sin A \sin B \sin C} \int_0^a \int_0^b \int_0^c (\mathbf{N})^2 dx dy dz$$

$$= \frac{1}{24} \left( \frac{a^2 \sin A}{\sin B \sin C} + \frac{b^2 \sin B}{\sin C \sin A} + \frac{c^2 \sin C}{\sin A \sin B} \right) = \frac{a^4 + b^4 + c^4}{48 \Delta}.$$

[Note.—Problems twenty-three and twenty-four are identical. This fact was not observed until after they were both printed. ED.]

## PROBLEMS.

31. Proposed by B. F. FINKEL, A. M., Professor of Mathematics and Physics in Drury College, Springfield, Missouri.

Find the average length of a line drawn at random across the opposite sides of a rectangle whose length is  $l$  and breadth  $b$ .

32. Proposed by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pennsylvania.

Find the average area of the random sector whose vertex is a random point in a given circle.

## MISCELLANEOUS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

## SOLUTIONS OF PROBLEMS.

17. Proposed by SAMUEL HART WRIGHT, M. D., M. A., Ph. D. Penn Yan, New York.

A bright star passed my meridian at 7 P. M. The Chronometer soon after ran down and stopped, but I set it again when the same star had a true altitude of  $30^\circ = \alpha$ . What time was it then, my latitude being  $42^\circ 30' \text{ N.} = \lambda$ , and the star's declination  $60^\circ \text{ N.} = \delta$

II. Solution by the PROPOSER.

Let  $B$  be the north pole,  $A$  the zenith,  $C$  the star,  $HH'$  the horizon,  $AH$  and  $AH'$  each  $= 90^\circ$ ,  $AH'$  being a meridian,  $AH$  a verticle circle,  $BH'$  the altitude of the pole = the latitude  $= L$ ,  $AB = \text{co-latitude} = c$ ,  $BC = a = \text{polar distance of the star} = P$ ,  $AC = b = \text{the zenith distance of star}$ ,  $CH = A = \text{altitude of the star}$ , and the angle  $ABC = \text{the hour-angle of the star} = T$  in sidereal time. Put  $s = \frac{1}{2}(a + b + c)$ , and  $s - a = a'$ ,  $s - b = b'$ , and  $s - c = c'$ . Then by *Sph. Trig.*

$$\sin \frac{1}{2} T = \sqrt{\left( \frac{\sin c' \sin a'}{\sin c \sin a} \right)}, \text{ and}$$

